Fostering Information Detection In The Visual Perception Of Relative Mass

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Recent research has suggested that novice perceivers might exploit non-specifying kinematic variables for the perception of kinetic properties, and graduate to the detection of specifying information after training (Michaels and de Vries, 1998; Jacobs, Michaels, and Runeson, 1999). Non-specifying variables that have been suggested as bases for the perception of the relative mass of colliding balls include the difference in “exit-speeds” (speeds after the moment of impact), the difference in “scatter-angles” (angles between the balls’ directions before and after impact), and a combination of these differences. The relative mass of colliding balls is specified by, for instance, their relative amount of motion change.

Participants in an experiment of Jacobs et al. (1999) seemed to exploit the exit-speed difference or the combination before training. After training with feedback, some observers came to detect information specifying relative mass, whereas others came to or continued to use the combination. Jacobs et al. suggested that those observers who continued to use the combination, despite the availability of specifying information, did so because it correlated highly ($r=.93$) with the mass ratios to be perceived, and hence allowed for reasonably accurate performance. Michaels and de Vries (1998) showed that observers flexibly educate their attention to variables that allow accurate performance in the particular collection of displays encountered in practice. This suggests that observers might converge on specifying information more easily if other candidate kinematic variables are not at all useful.
The purpose of the present experiment is, indeed, to test whether convergence on information specifying the relative mass of colliding balls can be facilitated. We created two practice sets of collisions that might serve this purpose: the no-variation and zero-correlation sets. During no-variation training, the exit-speed difference cannot be exploited because the balls have equal exit-speeds in all collisions. Furthermore, the scatter-angles are arranged to always differ by 40° or 100°, which makes them scarcely exploitable too. Hence, during no-variation practice, observers are forced to use other variables, which might facilitate convergence on specifying information.

In the zero-correlation training, the exit-speed and scatter-angle differences are free to vary but have correlations of near zero with the mass ratios. Hence, reliance on these variables will yield poor judgments. The corresponding feedback might guide observers to the use of other variables, possibly specifying information. A third training condition, the random training, is included as a control condition. Here, reliance on the exit-speed and scatter-angle differences can yield reasonably accurate performance, as in earlier experiments.

Method

Collisions were simulated and displayed by means of a one-of-a-kind analog computer. The experiment consisted of an 80-trial pretest, three 88-trial training blocks with feedback, and an 80-trial posttest. In the test phases, the mass ratios ranged from 1:4 to 4:1, and during training, they ranged from 1:3 to 3:1. Different practice sets of collisions were used for three groups of eight observers. The different sets were created by manipulation of the precollision velocities. In the no-variation set, the exit-speeds were always equal and the scatter-angles differed by 40° or 100°. In the zero-correlation set, the correlations between the mass ratios and the exit-speed differences, scatter-angle differences, and the combination were less than .03. In the test phases and random training, these correlations ranged from .50 to .91.
Results and Discussion

Figure 1. Correlations between the various kinematic variables and judgments for two observers in the no-variation group (upper panels) and zero-correlation group (lower panels), in the pretest (Block 1), training (Blocks 2, 3, and 4), and posttest (Block 5).

Observers seemed to be able to perceive relative mass. The correlations between the judgments and the simulated mass ratios differed significantly from zero (p < .05) in all but three (of 48) test blocks. To determine which kinematic variables observers exploited, we calculated, for each block of trials for each observer, the correlations between the candidate variables and the judgments. Observers differed and changed in the variables they used. Figure 1 shows the results from four observers. Observer 1 in the no-variation group seemed to exploit the exit-speed difference in the test phases (the combination did not correlate significantly higher with his judgments). During training, none of the considered variables correlated highly with his judgments. Observer 2 in
the no-variation group seemed to exploit mass-specifying information in all blocks. Both observers in the zero-correlations group exploited the exit-speed difference in the pretest and changed their strategies during training. Observer 1 came to detect mass-specifying information. Observer 2 also tried to use other variables but he did not discover specifying information.

Overall, observers in the no-variation group who relied on non-specifying variables in the pretest changed their strategy during training, but, in general, they returned to the use of non-specifying variables in the posttest. Observers in the zero-correlation group also changed their strategy. Five of them came to rely on specifying information and four continued to do so in the posttest; for these observers the zero-correlation practice seemed to be successful. Finally, most observers in the random group came to or continued to rely on the difference in exit-speed or on the combination, which correlated highly with the simulated mass ratios, but did not constitute specifying information.

Conclusions

The present experiment replicates the earlier findings that novice observers use non-specifying variables and converge on the more useful variables after practice. In addition, it suggests that convergence on specifying information might be facilitated, at least for some observers, by near zero correlations between non-specifying variables and the to-be-perceived property, but not by keeping non-specifying variables constant.

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References
